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ULTURE

COSTS OF OPERATING SELECTED FEED MILLS

as influenced by volume, services, and other factors

Marketing Research Report No. 79

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
in cooperation with the
Agricultural Experiment Stations of Iowa, Oregon and Tennessee

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No report of this type is possible without the basic data supplied by the individual plants and companies operating in the industry. Our first acknowledgment, therefore, must go to the individuals who cooperated with the survey. Not only did a majority of the companies and managers cooperate, but they cooperated completely even though it involved a considerable amount of time and effort.

We also wish to acknowledge the assistance given by the officers of the American Feed Manufacturers Association and some of the plant managers who were closely allied with this association. These people not only reviewed the objectives of the survey and helped us prepare a suitable schedule of questions, but they also helped, in an unofficial capacity, in obtaining cooperation.

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SUMMARY

Costs of operating differ considerably among feed-mixing plants, with much of the variation explained by differences in volume of feeds mixed. The influence of volume is especially important among the small-volume plants. For example, total operating costs per ton were about $10.40 in plants mixing 30,000 tons a year, $12.90 in plants with volumes of 10,000 tons, and $20.70 in plants mixing 2,000 tons a year during 1952.

Total wages and salaries represent between 57.0 and 61.2 percent of the total operating expenses in all plants mixing less than 45,000 tons a year. In plants mixing 45,000 tons or more, wages and salaries accounted for about 54 percent of the total operating expenses. The remainder of the expenses represent depreciation; maintenance and repairs; heat, light, and power; taxes and licenses; transportation and hauling; and insurance, interest, and all other, in approximately that order. "All other" expenses represented a much larger proportion of the total in those plants mixing 45,000 tons or more a year.

Among plants with fairly similar volumes of feed mixed, the greatest variations occurred in the cost of sales and office departments and related overhead expenses. Thus, plant operations are much more uniform when only production costs are considered. Consequently, the influence of volume and other factors can be studied with much greater accuracy when nonproduction expenses are excluded. Since it was believed to be impossible to obtain comparable estimates for the production phase of the operation for each individual cost item, only the wages and salaries in production have been obtained and analyzed.

The average wages and salaries paid for production, per ton of feed mixed, were as follows: About $9.50 in plants mixing 1,000 tons of feed a year, $5.90 in plants mixing 5,000 tons a year, and about $3.75 in plants mixing 30,000 tons a year. The volume of feed mixed appears to explain about 63 percent of the interplant variations in the per-ton costs for wages and salaries used in production. Approximately 6 1/2 man-hours were required per ton of feed mixed in plants mixing 2,000 tons a year, and about 2 1/3 man-hours were required per ton in plants mixing 25,000 tons a year in all areas of the country except the South. Approximately one-third more man-hours were required to produce a ton of feed in small and medium-sized plants in the South. However, lower wage rates tended to offset this difference.

Other interplant differences and their probable influence on these average per ton operating costs also were considered. Some of these other factors are type of product, operating volume as a percentage of capacity, seasonality of production, quantity pelleted, quantity bagged, and management decisions.

Individual plants vary considerably in the seasonal pattern of production. A study of production changes during a season in a small number of plants indicates that the wages and salaries paid for production decrease as volume increases seasonally in a given plant. Also the study indicates that as volume increases within a plant the production wages and salaries per ton tend to decrease at a decreasing rate.

Managerial decisions, however, appear to be a major reason for the unexplained variations in operating costs. Thus, in individual plants operating costs per ton do not necessarily decrease as volume increases, because management efficiency in handling labor and plant design exerts a considerable influence in determining the rate and direction of this movement. Further study of this phase is needed, on the basis of the findings of the present study.

COSTS OF OPERATING SELECTED FEED MILLS
as influenced by volume, services and other factors

By V. John Brensike and William R. Askew, Agricultural Economists
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INTRODUCTION

Unit costs of manufacturing and selling mixed feeds have increased more than 75 percent since 1939, mainly because of increased costs of labor and certain other factors. Even without considering this increase, each company must constantly seek to be in a low-cost position relative to its competitors. The relatively low-cost concerns are in a better position not only during rapid growth of the industry but also when this growth slows down or stops or when economic conditions turn downward.

Cost information, especially when it is related to services rendered, is important to a complete knowledge of any business. It is essential in order to control those factors that can be controlled and adjust rapidly and adequately to those factors that cannot be controlled. Sometimes, of course, increased expenditures may lead to an ultimate reduction in per-unit costs. But even in these instances, owners and managers should be aware that their operating costs are higher than they otherwise would be, and should realize why they desire to keep them at that level. Arbitrary reductions in expenditures should not be undertaken, as a rule, until the net effect of such reductions on the entire enterprise is considered.

The importance of buying the ingredients, containers, and other supplies as cheaply as possible for a given quality item is well known. It is the hope of the authors that this report will accomplish the following:

(1) Show plant managers the variation in operating costs primarily attributable to volume and those attributable to management, plant layout and so forth. This also permits them to compare the operations of their plant with other operating establishments. In addition, by looking at the establishment from this possibly new angle, managers may attempt to answer such questions as the following: Is the feed-mixing department profitable, and, if it is not, what portion of its costs of operation is being carried by some other department? Are the high or low costs of operating the establishment due to high or low costs of production, high or low costs of purchasing or selling, or both?

(2) Help potential feed mill owners and managers realize, before they buy a plant or set up a new one, the importance of the potential sales volume and the services required in influencing the plant design and per-unit costs of operation.

This report is the second in a series of studies of the feed milling industry. 1/ Subsequent case study analyses are planned in order to ascertain the influence of managerial decisions, plant design, and so forth. The present report analyzes the costs of operating 126 firms to determine the average per-unit costs for firms of various volumes, to show the influence of some of the major services on these costs, and to show the relative importance of some of the major individual cost items. This has been accomplished by analyzing (1) the total expenses of operating a feed-mixing establishment, (2) the wages and salaries paid for producing the mixed feed, and (3) the physical inputs of production labor used in producing the mixed feeds.

The term "total expenses," as used in this report, applies to the costs of operating feed-mixing establishments, including the costs incurred in purchasing, handling, warehousing, mixing, and selling. Ingredient costs, cost of freight in and out, and the costs for bags or other containers and tags were not considered. 2/

An earlier report 3/, showed the rapid growth that has occurred in this industry and the relative importance of the large number of independent concerns. Farmers purchase nearly all of the products produced and raise most of the ingredients used by the feed-mixing industry. Thus, if the industry is competitive, farmers tend to benefit as the average costs of mixing feed are reduced.

Sample Size and Geographic Location

This survey is based upon data collected from 126 feed manufacturing establishments located in four widely separated geographic areas of the United States, figure 1 and table 1. The 1947 Census of Manufactures shows a total of 2,689 firms operating in this industry.

Five of the 126 cooperating plants were excluded from the analysis. The operations of two were entirely different from those of the others--one producing and selling only mineral feeds and the other a soybean processing plant which also mixed some feeds. The other three plants were excluded because the only costs which they had available for the feed-mixing department were those of production, excluding such items as handling ingredients, storage, and handling of finished feeds. This definition of costs was much too restricted for comparison with the remaining plants.

1/ The first report was entitled "The Mixed-Feeds Industry," by William R. Askew and V. John Brensike. Mktg. Res. Rept. No. 38. U. S. Dept. Agr., Washington, D. C. May 1953.

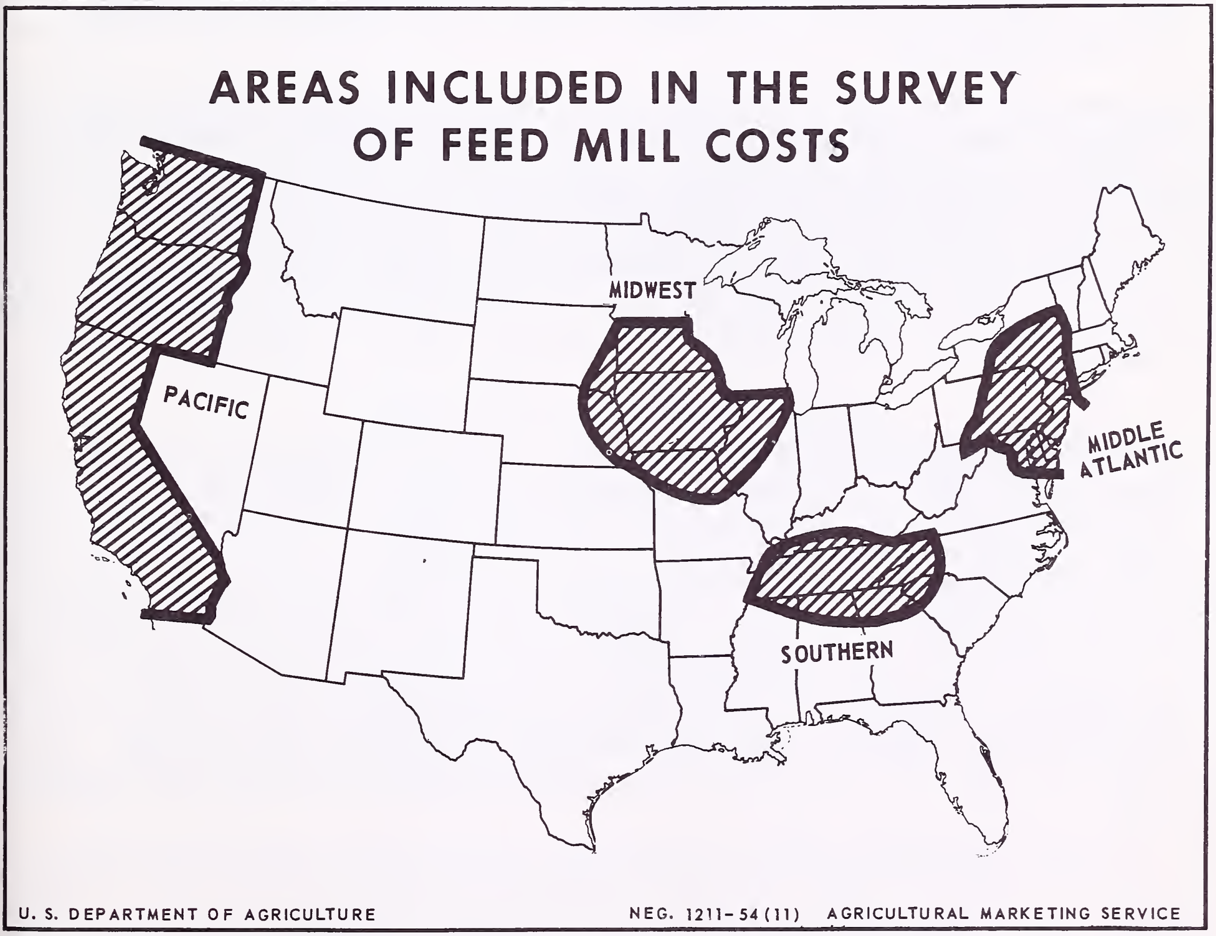
2/ A more complete list of definitions including those for production workers and so forth are contained in the methodology section of the appendix.

3/ William R. Askew and V. John Brensike, op. cit.

Table 1.- Plants visited and cooperating plants, by geographic areas

Area	Sample plants visited 1/	Cooperating plants
	Number	Number
Middle Atlantic	38	31
Southeast	60	23
Midwest	51	37
Pacific	55	35
Total	204	126

1/ Does not include alternate plants visited if the manager of the sample plant was away or refused to cooperate or if the plant did not manufacture feed.


AREAS INCLUDED IN THE SURVEY OF FEED MILL COSTS
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MIDWEST
MIDDLE ATLANTIC
SOUTHERN
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Figure 1

Information was obtained by personally interviewing the managers of a stratified random sample of the plants in the industry. Plants were stratified by volume and location before sampling at random. The sampling rate was somewhat heavier in the larger volume categories. The field work and summarization were conducted by representatives of the Agricultural Economics Department of Iowa State College, Oregon State College, the University of Tennessee, and the Agricultural Marketing Service. 4/

SERVICES RENDERED AND EQUIPMENT USED

Even though most of the mixed feeds are produced in plants primarily engaged in feed mixing, almost any study of the feed-mixing industry will include many plants which mix feed as a sideline operation. Regardless of the definition used, a number of these plants will be encountered, primarily because of the large number of them, but also because of the lack of sufficient information to separate them from plants in which feed mixing is the major part of the business. 5/

Fifty-one of the 121 cooperating plants included in the following analysis received all of their gross receipts from the feed department. Another 46 plants received more than 50 percent and only 24 plants received a minor part of their gross receipts from the feed department. As can be noted from table 2, most of these 24 plants handled less than 15,000 tons of feed a year. In these plants, the feed departments represented, on the average, less than 21 percent of the total business. Although plants of this type operate throughout the United States, the largest number of them were located in the Midwest.

4/ The methodology section of the appendix contains a much more complete discussion of the sampling procedure, schedule formation, interviewing procedure, and definitions used in conducting the survey. A comparison of the sample with the census also appears in the appendix.

5/ Feed milling was defined in this report to include grinding, pelleting, bagging, and merchandising of both individual grains and mixed feeds prepared by others as such (if the plant also mixed some feeds), as well as the actual mixing of feeds. The only major deviation from this definition occurred when the manager or owner thought the sales of ingredients large enough to be considered as being made by a grain elevator department and kept records which permitted separate cost allocations for the elevator and the feed mixing department.

Table 2.- Plants receiving specified percentage of gross receipts from feed, by volume of feed handled per year

Tons handled per year	Plants receiving 0-24 percent	25-49 percent	50-74 percent	75-99 percent	100 percent	Total plants
	Number	Number	Number	Number	Number	Number
Under 5,000	9	8	6	8	3	34
5,000 - 14,999	2	3	5	5	17	32
15,000 - 24,999	1	0	2	3	11	17
25,000 - 34,999	0	0	1	1	5	7
35,000 - 44,999	0	1	1	3	6	11
45,000 and over	0	0	5	6	9	20
Total	12	12	20	26	51	121

Operations, including services rendered and the costs of operation, may be considerably different in plants in which the feed department is minor as compared to plants in which it is a major part of the enterprise. Therefore, such plants will be kept separate in the remainder of this report unless they mixed more than 15,000 tons a year. In this event, the plant is considered to be a feed plant regardless of the percentage of gross receipts coming from the feed department.

Ingredient Purchases and Hauling

Over 70 percent of the grains and meal purchased by feed mills were delivered to the plant in bulk form rather than in bags. Even in the plants deriving less than 50 percent of their business from the feed department, two-thirds purchased 61 through 80 percent of their grain and meal in bulk form (table 3). Half of the plants receiving more than half of their gross receipts from the feed department, and operating under 5,000 tons a year purchased 61 through 80 percent of their grain and meals in bulk form. An additional one-third of these plants bought less than 20 percent of their ingredients in that form. Plants mixing 25,000 tons a year or more show a tendency to split fairly evenly into groups handling 61-80 percent and those handling 81-100 percent of their grain and meal in bulk form.

Many feed mixers hauled feed ingredients to the plants in their own trucks. These hauls include those made from warehouses, freight sidings, and elevators, as well as some from farms to the mill. Only 6 percent of the ingredients were, however, hauled in trucks owned by the mills. Most ingredients were moved by rail or contract carrier or were brought in by the producer. The quantity of ingredients hauled in mill trucks varied considerably between volume groups with plants in both the group under 5,000 tons and the group handling 15,000 to 24,999 tons using their own trucks 5 to 10 times as much as the largest-volume group.

Table 3.- Percentage distribution of plants purchasing specified percentage of grain and meal in bulk, by volume of feed handled per year

Item	Percentage of plants making bulk purchases of: 0-20 percent	21-40 percent	41-60 percent	61-80 percent	81-100 percent	Total
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Mills with gross receipts from feed department						
Less than 50 percent, handled under 15,000 tons 1/	14	5	5	68	8	100
50 percent or more, handled under 5,000 tons	31	0	19	50	0	100
5,000 - 14,999	4	4	4	57	31	100
15,000 - 24,999	0	0	6	50	44	100
25,000 - 34,999	14	0	0	43	43	100
35,000 - 44,999	0	0	10	60	30	100
45,000 and over	0	0	5	40	55	100

1/ Twenty of the twenty-three plants in this category mix less than 5,000 tons per year.

With the exception of plants in the smallest-volume group, there was little variation within groups in the use of mill trucks for hauling ingredients. Eighty percent or more of the plants in every group of mills mixing more than 5,000 tons hauled less than one-fourth of their ingredient requirements in their own trucks. About 40 percent of the plants mixing less than 5,000 tons hauled less than one-fourth of their total ingredients, whereas another 40 percent hauled over three-fourths in mill trucks. Slightly less than half of the plants that received under 50 percent of their gross receipts from feeds trucked less than one-fourth of their ingredients in mill trucks; the other half of these plants were almost equally divided between those trucking 26 to 50 percent and those trucking more than 75 percent.

Feed Mixing

Eighty-seven percent of the feed handled by plants primarily engaged in the feed business was mixed in the plant. In plants not primarily engaged in the feed business, mixing represented only 63 percent of the total feeds handled (table 4).

Table 4.- Percentage distribution of feed handled by feed mills, by operation performed and by volume of feed handled per year

Item	Feed mixed: Total excluding scratch	Feed mixed: Scratch	Ground and sold	Pelleted and sold	Bagged and sold	Merely merchandised	Total handled
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Mills with gross receipts from feed department							
Less than 50 percent, handled under 15,000 tons 1/	58.4	4.5	12.8	0.0	3.2	21.1	100.0
50 percent or more, handled							
under 5,000 tons	69.1	2.9	4.7	0.0	5.0	18.3	100.0
5,000 - 14,999	79.4	3.1	7.7	0.2	3.0	6.6	100.0
15,000 - 24,999	87.2	3.7	0.7	1.1	3.2	4.1	100.0
25,000 - 34,999	76.9	10.3	5.0	0.0	0.1	7.7	100.0
35,000 - 44,999	76.4	12.0	2.2	0.0	0.6	8.8	100.0
45,000 and over	88.7	3.7	3.7	0.0	0.8	3.1	100.0

1/ Twenty of the twenty-three plants in this category mix less than 5,000 tons a year.

This average is representative of plants primarily engaged in the feed business since about 80 percent of the plants mix more than 61 percent of the feed they handle. On the other hand, only about one-half of the plants not primarily engaged in the feed business mixed more than 61 percent of the feed handled.

Merchandising of feeds purchased and sold in the same form was the second largest type of operation carried out in the smaller plants (table 4). The remainder of their volume was distributed between grinding and bagging. Average plants in every volume group, except the group of plants that handled less than 5,000 tons a year, devoted between 82 and 91 percent of their output to mixing, with either grinding or merchandising ranking second in every group. Straight bagging of grains and feeds (excluding the bagging of feeds processed in the plant) was done to some degree by plants in every volume group but never exceeded 5 percent of the total output. Pelleting of grains and feeds (excluding pelleting of feeds mixed in the plant) exceeded 1 percent of the total volume only in the 15,000- to 24,999-ton group. This practice was performed in quantity in only one plant.

In plants handling between 25,000 and 44,999 tons a year, scratch feed comprised more than 10 percent of the total output. Scratch feed production was relatively constant at about 3 to 5 percent of the total output for the other volume groups.

Plants receiving less than 50 percent of their gross receipts from the feed department generally sold more feed after minor processing or merely retailed it without processing than did plants in any of the volume groups primarily engaged in feed milling. Feed mixing accounted for 62.9 percent of the total volume of feeds handled in these plants whereas merchandising of feeds mixed in other plants represented 21 percent. Grinding feed for sale as such was a common activity in these plants. It accounted for almost twice as much of the total volume handled as it did in any of the other volume groups.

Custom and contract mixing is another service available at many mills, especially smaller plants. The custom-mixing operation usually involves the mixing of high-protein concentrates with grains that are grown locally and grains that are owned by the producers. Contract mixing is also custom mixing for other plants, but in this type all of the ingredients come from plant stocks. This service was offered to some extent by plants in every volume group. In plants handling 5,000 or more tons per year, custom mixing varied from a low of 1 percent of the total feed mixed in the 45,000 and over ton group to about 8 percent of the total mixed in some of the smaller volume groups. However, in plants handling less than 5,000 tons a year and those with feed departments representing only a minor part of their business, it accounts for almost one-fourth of their total mixing volume.

Types of Feeds Mixed.- Feed mills may produce only one type of feed, for example, poultry or dairy, or a complete line of feeds. When plants manufacture one type of feed, there is a tendency to broaden the line and produce many different formulas and brands within this type. Most mills produce more than one type of feed, however, with nearly all of them turning out different formulas in each type. Most of these plants devoted more than 51 percent of their output of mixed feeds to one type of feed and one-third of the plants put more than 76 percent of their production into a single type of feed. More than half the plants produced poultry feed (excluding scratch) as the major type, while one-quarter of the plants concentrated on dairy feed. Relatively few plants restricted their production to only one type of feed, and most of these plants mixed less than 5,000 tons a year.

Poultry feed accounted for the largest proportion of the feed mixed in the average plant in each of the volume groups mixing 5,000 or more tons a year (table 5). In the plants handling under 5,000 tons and those with less than half their business in the feed department, dairy feed was the principal feed produced, followed closely by poultry feed. Dairy feed was the second most important feed produced in three of the larger volume groups while hog and scratch feed were the second most important type of feed produced by the remaining two groups.

Table 5.- Percentage distribution of feed mixed in average plants, by type and by volume of feed mixed per year

Item	Feed for -					High protein concen-trate	Other	Total
	Poultry		Beef cattle	Dairy cattle	Hogs			
	Mash	Scratch						
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Mills with gross receipts from feed department								
Less than 50 percent, mixed under 15,000 tons 1/	28.7	9.5	2.2	32.9	17.2	1.0	8.5	100.0
50 percent or more, mixed								
under 5,000 tons	34.5	5.9	6.2	38.1	12.9	1.2	1.2	100.0
5,000 - 14,999	52.7	3.5	8.7	26.5	3.9	1.3	3.4	100.0
15,000 - 24,999	61.6	3.8	0.8	11.7	15.9	2.9	3.3	100.0
25,000 - 34,999	42.7	12.3	4.4	23.4	7.8	2.0	7.4	100.0
35,000 - 44,999	54.9	15.9	6.2	15.2	3.1	0.2	4.5	100.0
45,000 and over	57.0	3.9	3.0	16.1	11.7	5.3	3.0	100.0

1/ Twenty of the twenty-three plants in this category mix less than 5,000 tons a year.

The greatest variation in a particular type of feed was found in high-protein feeding or mixing concentrates. Production of this feed ranged from a low of 0.2 percent to a high of 5.3 percent. The proportion of beef cattle feed production was more than 10 times as great in the 5,000- to 14,999-ton group as in the 15,000- to 24,999-ton group. Hog feed represented a larger proportion of feed mixed in the plants receiving less than 50 percent of their gross receipts from the feed department than in any of the other groups. This probably can be accounted for by the number of Midwestern plants falling in this category.

The mixed-feeds industry is continually using more vitamin carriers, trace elements, and antibiotics. Only an extremely small portion of a ton of feed is composed of these ingredients, and mixing such minute quantities poses a problem in most plants. Plants that lacked the equipment needed for this operation usually bought their vitamins, trace elements, and antibiotics in a premix. Other plants, however, purchased the individual ingredients on a carrier and mixed each into their formula. More than 95 percent of the plants surveyed used these ingredients, their use being rather uniform by plants in every volume group.

High-protein concentrates are made for use both as a mixing concentrate and as a feeding concentrate. The mixing concentrates are used by feed manufacturers both for their own brands of feed, for sale to other mixers, and in custom mixing. More than half the plants surveyed used high-protein concentrate either part of the time or all of the time. Plants mixing less than 15,000 tons were the largest users of these concentrates. Most plants mixing 15,000 tons or more reported that they never used concentrates produced in other plants. As with the vitamins, trace elements, and antibiotics, there is a greater tendency for large mixers to build their feeds from the ground up rather than to use premixes.

Equipment Used by Feed Mills.- A variety of equipment is required to manufacture formula feeds. The principal machine is the mixer, which probably does more to determine the physical capacity of the mill than any other piece of equipment. It must, of course, be recognized that poor planning or inadequate facilities for material flow can cause any mill to fail to achieve the effective capacity of their mixers.

Two principal methods of operation are used in producing mixed feeds. The most popular method is the batch mix. This method was used by 85 percent of the plants studied. The line mix, in which proportioned ingredients are fed to a moving belt or screw conveyor from individual bins, was used by 9 percent of the plants. The remaining 6 percent of the plants used a combination of the line and batch-mix operation. Plants mixing less than 5,000 tons a year, as well as those with less than 50 percent of their gross receipts in feeds, used the batch method exclusively. One plant mixing between 5,000 and 14,999 tons a year used a line mix operation, whereas four plants mixing between 15,000 and 34,999 tons a year used the combination batch-line method. In plants mixing 35,000 tons or more a year, the number of plants using the batch method was equal to the total number using the line and batch-line methods.

The average total capacity of mixers in plants mixing less than 5,000 tons a year was only one-tenth that of mixers in plants in the largest volume group (table 6). The average total capacity includes both batch and line mixers. The average capacity of line and combination batch-line mixers was over 3 times the average capacity of batch mixers, because line mixers are found principally in larger mills. Combination batch-line mixers are grouped with the line mixers because they more closely approximate the line mixers' style of operation.

More than half the grinding machines used were hammer mills. Many plants used a combination of one or more of these along with attrition mills, corn cutters, crackers, crimpers, and various other grinding equipment. Hammer mills were used the most frequently and attrition mills ranked second in every group. The average number of grinders per plant is shown in table 6.

The proportion of mills having pellet machines, machinery for conveying bulk ingredients, and bag conveyors also appears in table 6. Almost all of the plants mixing more than 15,000 tons a year used pellet machines. But only one-fourth of the plants mixing less than 5,000 tons and two-thirds of the plants in the 5,000- to 14,999-ton group had these machines. Machinery for conveying bulk ingredients were found in practically every plant, especially those over 5,000 tons. Conveyors for handling bags of feed were found in every volume group but they were not used as much as bulk conveyors even in plants mixing more than 15,000 tons a year.

Table 6.- Equipment used in feed mills by volume of feed mixed per year

Item	Capacity of mixer per hour 1/			Average number of grinders per plant	Proportion of plants having -		
	Batch	Line	Average total		Pellet mills	Bulk conveyors	Bag conveyors
	Tons	Tons	Tons	No.	Pct.	Pct.	Pct.
Mills with gross receipts from feed department							
Less than 50 percent, mixed under 15,000 tons 2/	3/ 3.8	0.0	3/ 3.8	1	13	70	22
50 percent or more, mixed							
under 5,000 tons	3.2	0.0	3.2	1	24	84	8
5,000 - 14,999	8.4	13.0	8.6	2	69	100	68
15,000 - 24,999	12.8	10.0	12.5	3	92	100	89
25,000 - 34,999	20.9	36.3	26.7	3	100	100	100
35,000 - 44,999	18.4	29.8	23.0	3	100	100	100
45,000 and over	22.4	42.4	32.4	5	94	100	88

1/ Combination batch-line mixers classed as line mixers.

2/ Twenty of the twenty-three plants in this category mix less than 5,000 tons a year.

3/ For the 20 plants with a mixed-feed volume of less than 5,000 tons, the average capacity is 2.6 tons an hour.

Sales and Related Services

In recent years the trend has been toward bulk handling of finished feeds. Data obtained indicate that 13 of the 121 plants sold over two-thirds of their feeds in this form. Sales of feed in bulk form were prevalent in the Pacific region. However, the greater part of the feeds sold, even in the Pacific region, are still bagged.

At least two-thirds of the total feed sold in each volume group was bagged in the plants (table 7). In every volume group, more than 80 percent of the plants bagged more than one-half of their output, with 58 percent of the plants bagging more than three-fourths. Of the mills that received less than 50 percent of their gross receipts from feed, more than half bagged 75 percent or more of their output, and one-fourth bagged less than 50 percent.

Table 7.- Proportion of the feed bagged, pelleted, and delivered by volume of feed mixed per year

Item	Proportion of		
	Total sales bagged in plant	Feed ground or mixed, pelleted in plant	Sales delivered in mill trucks
	Percent	Percent	Percent
Mills with gross receipts from feed department			
Less than 50 percent, mixed under 15,000 tons 1/	67.6	9.9	55.4
50 percent or more, mixed under 5,000 tons	80.2	13.6	65.7
5,000 - 14,999	71.6	28.1	61.2
15,000 - 24,999	77.9	43.0	63.4
25,000 - 34,999	86.4	22.4	43.5
35,000 - 44,999	67.1	29.3	46.6
45,000 and over	83.5	37.1	31.2

1/ Twenty of the twenty-three plants in this category mix less than 5,000 tons a year.

In each volume group mixing 5,000 or more tons a year, between 22.4 and 43.0 percent of the feed ground or mixed was pelleted in the plant (table 7). Approximately 10 percent was pelleted in the group under 5,000 tons a year and the plants in which the feed department was a minor portion of the business. As can be expected, since it has already been shown that many plants have no pelleting machines (table 6), pelleting varied considerably among plants. Of the 51 plants that do not pellet any feed, 36 either mixed less than 5,000 tons a year or the feed department represented less than 50 percent of their gross receipts. No plant pelleted its entire output, but 14 pelleted more than 75 percent of the feed ground or mixed in the plant.

Average plants in the two smallest-volume groups and in the 25,000- to 34,999-ton group sold most of the feed they produced directly to consumers, and the next largest share of their sales went to retailers (table 8). Sales to retailers were largest in the three remaining volume groups, while sales to consumers ranked second.

The variation between volume groups in proportion of sales made to any one class of customers was greatest for sales made to wholesalers and brokers. Sample plants mixing 25,000 to 34,999 tons a year made the largest proportion of sales to wholesalers and brokers, while plants mixing 15,000 to 24,999 tons a year made the largest proportion of sales to other mixers. Except that they made no sales to other mixers, plants receiving less than 50 percent of their gross receipts from the feed department had similar sales distribution patterns to those having less than a 5,000-ton volume.

Table 8.- Distribution of total sales by type of customer, by plant category and volume of feed handled per year

Item	Consumers	Retailers	Wholesalers and brokers	Other mixers	Total
	Percent	Percent	Percent	Percent	Percent
Mills with gross receipts from feed department					
Less than 50 percent, handled:					
under 15,000 tons 1/	71.0	21.7	7.3	0.0	100.0
50 percent or more, handled					
under 5,000 tons	74.0	15.5	5.5	5.0	100.0
5,000 - 14,999	57.6	33.7	7.9	0.8	100.0
15,000 - 24,999	31.6	51.7	6.1	10.6	100.0
25,000 - 34,999	47.1	35.0	14.9	3.0	100.0
35,000 - 44,999	43.5	55.4	1.1	0.0	100.0
45,000 and over	23.5	68.4	7.1	1.0	100.0

1/ Twenty of the twenty-three plants in this category mix less than 5,000 tons a year.

Slightly more than two-thirds of the plants mixing less than 5,000 tons a year made 80 percent or more of their sales directly to consumers. More than one-third of the plants mixing between 5,000 and 24,999 tons a year made over 80 percent of their sales directly to consumers. An additional one-third of the plants in each of these two volume groups made less than 20 percent of their sales directly to consumers. More than four-fifths of the plants receiving less than 50 percent of their gross receipts from the feed department sold more than 80 percent of their feeds directly to consumers.

Another service rendered by many mills is delivery of purchases to the buyer. Delivery of grains and feeds in mill trucks ranged from a high of 65.7 percent of the total in plants mixing less than 5,000 tons to a low of 31.2 percent in plants mixing 45,000 tons or more (table 7). Generally, as mills grew larger delivery to purchasers in mill trucks decreased. Within volume groups there was considerable variation in the use of mill trucks for delivery.

COST OF OPERATION

All information on the cost of operating feed mills summarized in this report pertains to the last fiscal year for which records were available in each plant at the time of the visit. No attempt was made to have the plant manager or other employees rework the cost information in order to fit it into a given accounting period. The reason was that it was felt that this would not only be an exceedingly difficult task but would also reduce the possibility of obtaining cooperation. All volume and service information collected on the rest of the schedule were obtained for the comparable fiscal year in each plant. Since all of the visits were completed during the period July 1 to December 1, 1953, most of the information collected covers at least half of the year 1952. The fiscal years involved in this survey varied as shown in table 9 by plants operating in the various volume groups.

Table 9.- Number of plants reporting cost information for specified fiscal years, by feed mixed per year, 1951-53

Tons of feed mixed	Total number of plants	Fiscal year beginning in 1951 and ending in 1952	Calendar year 1952	Fiscal year beginning in 1952 and ending in 1953
	Number	Number	Number	Number
Under 5,000......	42	7	20	15
5,000 - 14,999...	37	5	16	16
15,000 - 24,999..	12	0	3	9
25,000 - 34,999..	8	2	5	1
35,000 - 44,999..	10	0	3	7
45,000 and over..	17	1	6	10
Total......	126	15	53	58

In the cost analysis, emphasis was placed on (1) the total cost of operating feed-mixing establishments as they existed in the industry at the time of the survey and (2) the labor costs, especially the wages and salaries paid to production workers. Thus, no attempt was made to define each of the various cost items or to rework each plant's fiscal-year cost records to fit specific item definitions. An exception was made for labor and a few of the other troublesome and larger individual cost items. 6/

The following sections of the report exclude from the operating cost analyses all plants receiving less than 50 percent of their gross receipts from the feed department, unless they mixed more than 15,000 tons of feed a year. These small diversified plants were included in the sample to be interviewed for the following reasons: (1) It was diffcult, if not impossible, to exclude them on the basis of the data available; (2) the large number of them makes them important; and (3) it was hoped that they would be able to allocate costs between departments accurately enough for the cost data to be usable. Twenty-three plants of this sort were included in the plants reporting, but the variations in costs were considerable. Thus, rather than arbitrarily exclude the extremes and possibly influence the results, all plants coming under this definition were excluded from the cost analysis. These 23 plants obtained an average of only 20 percent of their gross receipts from the feed departments. It should be noted that the costs of all plants supplying the necessary information and meeting the above definition are included in each of the following analyses. No attempt was made to arbitrarily exclude plants with extremely high or low costs.

Differences Among Geographic Regions

Costs of operating feed-mixing plants do not appear to differ significantly between various major geographic regions of the United States. This is true both for total operating expenses per ton mixed and for the major cost item of wages and salaries per ton mixed (table 10).

Although it is possible to compute mathematically an average cost of operating feed-mixing establishments in each of the four areas covered by this survey, it is believed it would not be a meaningful average because of the following reasons:

(1) The sampling problems 7/ make it impossible to know whether or not the samples are truly representative of each geographic area.

(2) Operating costs vary so much from plant to plant that, if averages are not computed among plants of similar operating volumes, the average costs would be meaningless.

6/ The methodology section in the appendix includes a complete discussion of the sampling procedure, schedule formation, interview procedure, and definitions used in conducting the survey. A comparison of the sample with the census also appears in the appendix.

7/ See methodology section of the appendix.

Table 10.- Expenses per ton for operating feed-mixing establishments, by regions and by volume of feed mixed per year

Tons of feed mixed	Cost per ton							
	Total				Wages and salaries			
	Mid-Atlantic	South	Mid-west	Pacific	Mid-Atlantic	South	Mid-west	Pacific
	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
Under 5,000......	17.25	14.20	15.19	19.23	10.12	7.65	8.33	10.57
5,000 - 14,999...	14.75	11.39	11.24	14.45	7.80	6.80	6.56	9.48
15,000 - 24,999..	11.77	1/	12.63	9.99	7.15	1/	7.91	5.83
25,000 - 34,999..	13.63	9.82	10.65	10.23	8.06	5.73	6.73	5.40
35,000 - 44,999..	9.20	1/	7.05	10.48	5.25	1/	4.45	6.71
45,000 and over..	1/	7.95	11.03	7.58	1/	4.19	6.22	3.83

1/ No plants cooperated.

Although the data summarized in table 10 imply that the South and Midwestern areas may have somewhat lower operating costs per ton than do the Mid-Atlantic and Pacific regions, the differences are not statistically significant. Not only do these regional differences shift by volume groups, but even if the plants are grouped in operating volume categories, the plants still vary considerably from the group average costs (tables 11 and 15). 8/

When the individual plant cost information is considered, it is found that there is no significant difference between plants in various geographic regions. This fact is shown clearly by figures 2 and 3, which are discussed in detail later in this report. These figures show, for total expenses and for wages and salaries paid for production, respectively, that the line of average relationship for the industry describes fairly adequately the industry in each of the four geographic areas. In other words, the individual plant plottings for each region tend to distribute on both sides of the industry trend line.

In view of this fact, most of the remaining sections will be concerned with analyzing the costs, volumes, and services rendered for the entire feed-mixing industry, rather than with an area-by-area discussion. The area studies tend not only to disclose negligible regional differences but also tend to substantiate the findings and results of each individual survey.

Total Expenses and Major Cost Items by Operating Volume Groups

Expenses of operating feed-mixing plants vary considerably with the volume of operation. The simple average of the total operating expenses for the

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8/ A large proportion of this variation can still be explained by the influence of volume on the costs of operation.

individual plants ranged from a high of $21.38 a ton in plants mixing less than 5,000 tons a year to only $8.81 a ton for plants mixing 45,000 tons a year or more (table 11).

Table 11.- Number of plants and average total costs per ton of feed mixed, by tons of feed mixed per year 1/

Tons of feed mixed	Plants	Individual plant costs per ton: Range of costs reported	Individual plant costs per ton: Simple average per ton 2/	Individual plant costs per ton: Range of 68 percent of plants 3/	Weighted average per ton 4/
	Number	Dollars	Dollars	Dollars	Dollars
Under 5,000........	21	9 - 71	21.38	6.43 - 36.33	16.43
5,000 - 14,999......	30	8 - 21	13.01	9.84 - 16.18	13.01
15,000 - 24,999....	12	5 - 23	11.74	6.92 - 16.56	11.84
25,000 - 34,999....	8	6 - 15	11.02	7.90 - 14.14	10.98
35,000 - 44,999....	10	5 - 15	9.30	6.20 - 12.40	9.30
45,000 and over....	17	4 - 14	8.81	5.94 - 11.68	9.14

1/ Whenever column 3 exceeds column 5, volume differences within the group explain some of the variations in per unit costs. The greater the discrepancy in this respect, the more of the variation is explained by volume differences.

2/ Average of the per ton costs for individual plants.

3/ Plus and minus one standard deviation from the mean of the group.

4/ Total costs for each group of plants divided by the tons mixed.

The variation of the individual plant costs from the volume group averages are still quite large, especially in the lower volume groups (table 11). Thus, it is seriously questioned whether these group averages, for plants with volumes of less than 15,000 tons of feed mixed a year, can be used for much more than a simple picture of some of the tendencies underlying the entire industry structure. Actually, however, much of the remaining variation in per-unit operating costs, especially in the two lower operating volume groups, are still explained by volume. Thus, the cost of $71 per ton is not only the highest plant cost figure but also represents the smallest-volume plant in the study. This can be noted readily by dividing the total costs incurred in all the plants in each volume area by the total volume of feed mixed and comparing the results with the average cost obtained by averaging the individual plant per-unit costs (table 11).

Wages and salaries account for between 57.0 and 61.2 percent of the total operating costs in feed-mixing plants with volumes of less than 45,000 tons a year. In plants with 45,000 tons a year or more, wages and salaries account for only about 54.2 percent of the total costs of operation (table 12).

Table 12.- Percentage distribution of the various individual cost items in the total costs of operation of feed mills, by tons of feed mixed per year

Tons of feed mixed	Wages and salaries	Depreciation	Heat, light, and power	Taxes and licenses	Transportation and hauling	Insurance	Maintenance and repairs	Interest	All other	Total
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Under 5,000......	57.0	8.9	3.7	3.3	7.5	3.9	3.4	3.7	8.6	100.0
5,000 - 14,999...	60.6	7.2	3.5	3.5	2.8	3.8	4.6	3.0	11.0	100.0
15,000 - 24,999..	61.2	6.9	4.0	3.3	0.4	3.3	2.9	2.5	15.5	100.0
25,000 - 34,999..	57.1	6.0	3.1	2.6	3.2	2.1	4.4	5.3	16.2	100.0
35,000 - 44,999..	61.2	5.3	3.5	2.8	3.9	3.5	4.7	3.6	11.5	100.0
45,000 and over..	54.2	5.5	3.7	2.8	0.4	1.6	5.7	2.7	23.4	100.0

As the operating volume of the plants increased, depreciation, taxes and licenses, and insurance all tended to decrease as a proportion of the total operating expenses per ton of feed mixed. On the other hand, maintenance and repairs and all other expenses tended to increase as a proportion of total expenses per ton of feed mixed (table 12).

In terms of actual per-unit costs of operating feed-mixing plants, all of the major cost categories decreased as the average tons of feed mixed increased (table 13). As would be expected, the relatively fixed costs decreased most rapidly as the average plant volumes increased. Wages and salaries followed.

Table 13.- Average costs per ton of feed mixed, by major items and by tons of feed mixed per year

Tons of feed mixed	Cost per ton of feed mixed							
	Average				Percentage decrease from smallest group			
	Wages and salaries	Fixed expenses 1/	All other 2/	Total	Wages and salaries	Fixed expenses	All other	Total
	Dol.	Dol.	Dol.	Dol.	Pct.	Pct.	Pct.	Pct.
Under 5,000.....	9.31	3.84	3.28	16.43	0	0	0	0
5,000 - 14,999..	7.89	2.72	2.40	13.01	15	29	27	21
15,000 - 24,999.	7.27	2.37	2.20	11.84	22	38	33	28
25,000 - 34,999.	6.26	2.09	2.63	10.98	33	46	20	33
35,000 - 44,999.	5.70	1.75	1.85	9.30	39	54	44	43
45,000 and over.	4.94	1.50	2.70	9.14	47	61	18	44

1/ Including depreciation; heat, light, and power; taxes and licenses; insurance, and interest.

2/ Including transportation and hauling, maintenance and repairs, and all other.

For many reasons, the wages and salaries paid to production workers, and officers and others to supervise production are shown later in the report to be the most workable measure for interplant comparisons. For this reason, table 14 summarizes the average per-ton costs for wages and salaries in production in much the same manner that table 11 did for per-ton total costs. Averages in table 14 are somewhat more representative of the individual plants than are those in table 11. Also, volume still explains much of the variation in costs in the smallest-volume group and some of the variation in the group with volumes of 5,000 to 14,999 tons a year.

Table 14.- Average expenses for wages and salaries in production, per ton of feed mixed, by tons of feed mixed per year

Tons of feed mixed	Plants	Expenses for wages and salaries in production			
			Individual plants		
		Weighted average 1/	Range of costs reported	Average per unit 2/	Range of 68 percent of plants 3/
	Number	Dollars	Dollars	Dollars	Dollars
Under 5,000	20	6.67	4 - 24	8.06	3.47 - 12.65
5,000 - 14,999	29	5.29	2 - 10	5.40	3.46 - 7.34
15,000 - 24,999	10	4.31	2 - 8	4.20	2.39 - 6.01
25,000 - 34,999	8	3.90	3 - 6	3.98	2.90 - 5.06
35,000 - 44,999	10	3.21	2 - 5	3.24	2.25 - 4.23
45,000 and over	17	3.24	2 - 7	3.34	2.04 - 4.64

1/ Total costs for each group of plants divided by the tons mixed.
2/ Average of the per-ton costs for individual plants.
3/ Plus and minus one standard deviation from the mean of the group.

Equipment, Services, and Costs Incurred in Hypothetical Average Plants

Table 15 is an effort to bring into focus in one table the pertinent data on the costs, services, and equipment used. Each item is the weighted average of the plants operating in these various volume groups, and it must be remembered that these averages are still influenced by volume, especially in the two lowest-volume groups. It does, however, indicate the kinds of operations performed, the costs incurred, and the equipment used. More detailed analyses of the operating costs and the factors influencing them are discussed in the rest of the report.

FACTORS INFLUENCING THE COSTS OF OPERATION

Many factors influence the total costs of operating feed-mixing establishments and the major individual costs item, wages and salaries. Some of the major factors influencing these costs--volume of operation, type of services rendered, size and type of sales force and superstructure, type of production, and percent of capacity used for current operation--will be analyzed in the following sections.

As was noted in the preceding sections, one of the most important individual factors is the volume of operation. It was pointed out that industry average costs would have little meaning because of the variations in operating volumes and the resultant influence on operating costs. Even average costs for groups of plants with fairly similar volumes lose their value in the lower volumes because of the tremendous influence of volume.

Table 15.- Summary of operations performed, cost of operations and equipment used, by the average mill in each volume grouping

Item	Unit	Summary by tons of feed mixed					
		Under 5,000	5,000-14,999	15,000-24,999	25,000-34,999	35,000-44,999	45,000 and over
Plants	Number	21	30	12	8	10	17
Operations:							
Feed as a percentage of gross receipts	Percent	78.6	89.4	96.6	92.8	86.1	88.8
Feed handled or sales:							
Mixed 1/	Ton	2,238	9,651	19,429	30,759	37,972	80,923
Percentage distribution:							
Poultry mash	Percent	34.5	52.7	61.6	42.7	54.9	57.0
Scratch	do.	5.9	3.5	3.8	12.3	15.9	3.9
Beef cattle	do.	6.2	8.7	0.8	4.4	6.2	3.0
Dairy cattle	do.	38.1	26.5	11.7	23.4	15.2	16.1
Hogs	do.	12.9	3.9	15.9	7.8	3.1	11.7
High-protein concentrate	do.	1.2	1.3	2.9	2.0	0.2	5.3
All other	do.	1.2	3.4	3.3	7.4	4.5	3.0
Minor processing	Ton	444	1,620	1,188	3,383	1,212	4,599
Merchandised (only)	do.	565	880	1,068	2,209	4,608	2,854
Total handled or sales	do.	3,247	12,151	21,685	36,351	43,792	88,376
Percentage of -							
Sales, bagged	Percent	80.2	71.6	77.9	86.4	67.1	83.5
Ground or mixed, pelleted	do.	13.6	28.1	43.0	22.4	29.3	37.1
Mixed, which is custom	do.	24.6	6.5	2.9	8.3	1.9	0.7
Grain and meal purchased in bulk	do.	57.8	74.1	80.8	74.9	77.2	87.2
Ingredients hauled in own truck	do.	40.6	7.9	19.9	5.4	10.9	3.9
Sales delivered in own truck	do.	65.7	61.2	63.4	43.5	46.6	31.2
Sales to -							
Consumers	do.	74.0	57.6	31.6	47.1	43.5	23.5
Retailers	do.	15.5	33.7	51.7	35.0	55.4	68.4
Wholesalers or brokers	do.	5.5	7.9	6.1	14.9	1.1	7.1
Other mixers 2/	do.	5.0	0.8	10.6	3.0	0.0	1.0
Operating tonnage as a percent of capacity	do.	37.8	43.6	51.3	59.9	68.8	70.7
Proportion of plants using trace elements, vitamin carriers, or antibiotics	do.	90.0	100.0	100.0	100.0	100.0	94.1
Cost of operating feed mills							
Cost per ton of feed mixed	Dollar	16.43	13.01	11.84	10.98	9.30	9.14
Percentage distribution:							
Wages and salaries	Percent	57.0	60.6	61.2	57.1	61.2	54.2
Depreciation	do.	8.9	7.2	6.9	6.0	5.3	5.5
Heat, light and power	do.	3.7	3.5	4.0	3.1	3.5	3.7
Taxes and licenses	do.	3.3	3.5	3.3	2.6	2.8	2.8
Transportation	do.	7.5	2.8	0.4	3.2	3.9	0.4
Insurance	do.	3.9	3.8	3.3	2.1	3.5	1.6
Maintenance and repair	do.	3.4	4.6	2.9	4.4	4.7	5.7
Interest	do.	3.7	3.0	2.5	5.3	3.6	2.7
All other	do.	8.6	11.0	15.5	16.2	11.5	23.4
Wages and salaries in production	Dollar	6.67	5.29	4.31	3.90	3.21	3.24
Man-hours in production	Hour	5.69	3.86	2.26	2.72	1.86	1.90
Equipment							
Batchmixer							
Plants	Number	21	29	11	5	6	8
Average capacity per plant per hour 3/	Ton	3.2	8.4	12.8	20.9	18.4	22.4
Linemixer							
Plants 4/	Number	0	1	1	3	4	9
Average capacity per plant per hour 4/ 5/	Ton	0.0	13.0	10.0	36.3	29.8	42.4
Grinder, average per plant	Number	1	2	3	3	3	5
Percentage of plants with -							
Pellet mills	Percent	24.0	69.0	92.0	100.0	100.0	94.0
Bulk conveyor	do.	84.0	100.0	100.0	100.0	100.0	100.0
Bag conveyor	do.	8.0	68.0	89.0	100.0	100.0	88.0
More than one shift	do.	4.8	33.3	41.7	62.5	70.0	76.5

1/ Data are underlined solely for the purpose of emphasizing items of special interest to the industry.
2/ Including movement to decentralized retail outlets owned by the company.
3/ For 95 percent of the plants which reported this item.
4/ Includes combination batch-line plants.
5/ For 89 percent of the plants which reported this item.

Operating Volume and Total Costs of Operation

In about 56 plants out of 100, the total operating expenses in plants mixing less than 2,000 tons of feed a year were more than $30 per ton of feed mixed. On the other hand, no plant mixing 25,000 tons a year or more had a per-ton cost of more than $15, and 57 percent of them operated at a cost of less than $10 (table 16).

Table 16.- Percentage of establishments reporting total operating expenses per ton of feed mixed, by amount of cost and by operating volume 1/

Tons of feed mixed	Plants	Under $10	$10-14.99	$15-29.99	$30 and over	Total
	Number	Percent	Percent	Percent	Percent	Percent
Under 2,000	9	0	22	22	56	100
2,000 - 4,999	12	18	55	27	0	100
5,000 - 14,999	30	17	63	20	0	100
15,000 - 24,999	12	42	42	16	0	100
25,000 and over	35	57	43	0	0	100

1/ Ninety-eight establishments with more than 50 percent of gross receipts from the feed department.

A plant mixing 30,000 tons of feed a year would be expected to have a total operating cost per ton of feed mixed of about $10.40; one mixing 10,000 tons, a per-ton cost of about $12.90; and one mixing 2,000 tons, a cost of about $20.70 (fig. 2). These and any other approximate industry average costs per ton of feed mixed can be obtained by (1) determining how many tons of feed a plant mixes a year, for example, 20,000 tons, (2) finding it on the X axis, (3) reading straight up until the line of average relationship is encountered, and then (4) going horizontally to the left and reading off the estimated industry average cost. The answer in this example would be about $11.58 per ton.

The line of average relationship for the industry has not been extended beyond the 54,000-ton-per-year line. The reason is that plant differences, such as sales channels and policies, office and supervisory superstructure, and so on, seem to differ considerably in the larger plants. 9/ Differences of this type in the smaller-volume groups apparently increased the variation but could not cover up the underlying trend.

9/ When these factors are excluded in a later section of the report, plants surrounded by the dash lines, figure 2, drop down into line with the others.

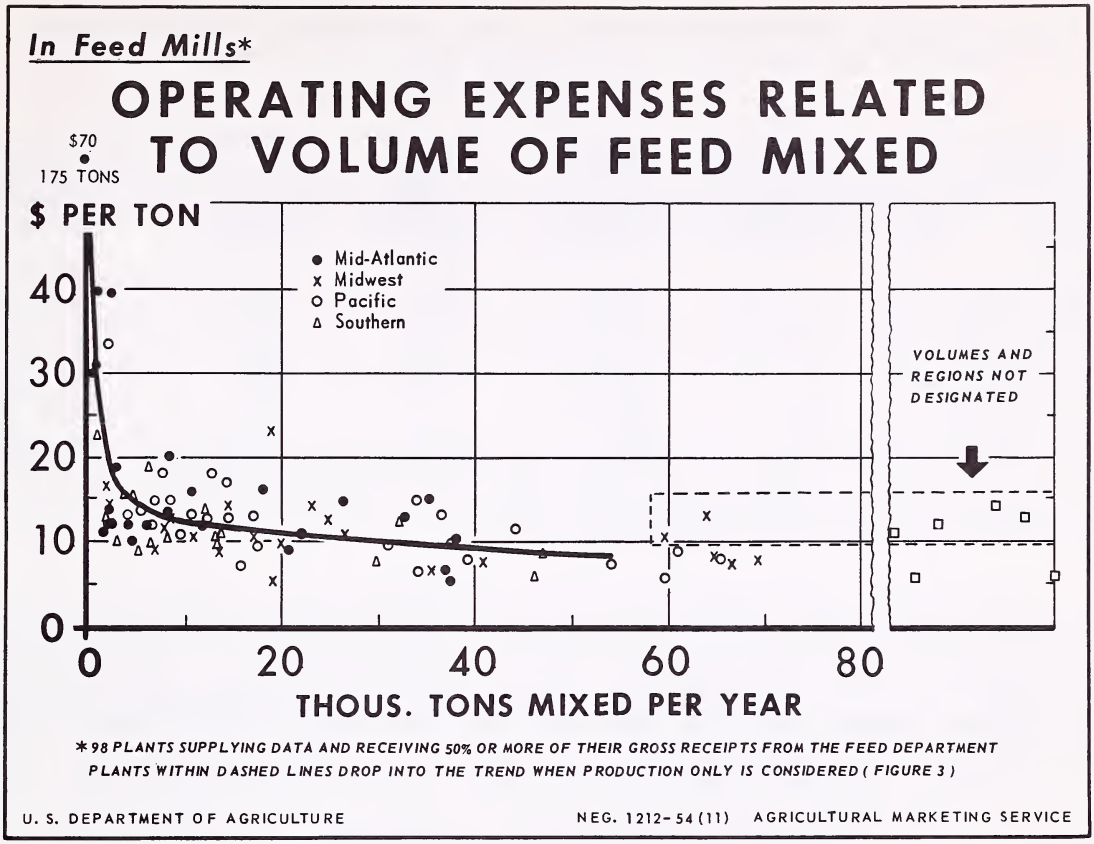

Figure 2

Variations in Nonproduction Items Which Influence Costs

Large differences exist in the sales channels and policies and the office and supervisory superstructure of plants among the various major geographic areas and within each of these areas. The chapter on services rendered has shown these variations in terms of sales channels, delivery, hauling of ingredients, and similar items. Perhaps the easiest way to summarize the great influence of these differences on total operating costs is to analyze the data contained in table 17.

Thus, some plants pay as much as 77 percent of their wages and salaries to nonproduction workers, whereas other plants have their sales and other nonproduction personnel operating under a home office, and pay them little or no wages and salaries. These large variations in plant operations can be reconciled only by allocating home office expenses or by getting all plants on a more common base--for example, a production-expense basis--where these

Table 17.- Average percentage of total wages and salaries paid by feed-mixing mills to workers not engaged in production, by volume groups and geographic areas

Tons of feed mixed	Mid-Atlantic	South-east	Mid-west	Pacific	Range
	Percent	Percent	Percent	Percent	Percent
Under 5,000	33	11	36	35	3 - 63
5,000 - 14,999	39	25	22	40	0 - 77
15,000 - 24,999	52	[1]	37	40	5 - 63
25,000 - 34,999	48	42	21	31	0 - 60
35,000 - 44,999	41	[1]	9	57	7 - 70
45,000 and over	[1]	27	40	22	4 - 60
Range	3 - 63	4 - 59	5 - 63	0 - 77	0 - 77

[1] No plants of this size cooperated.

differences are excluded. Going all the way in this respect was not deemed possible because of the problems that would be encountered, for example, in allocating all the minor expense items to production and nonproduction expenses. It was possible, however, to take the major expense item, that is, wages and salaries, and make this breakdown. [10]

Volume and the Wages and Salaries Paid for Production

Nearly all plants mixing 15,000 tons a year or more pay wages and salaries of less than $6 a ton for production (table 18). On the other hand, nearly all plants with a volume of less than 2,000 tons a year pay more than $6 a ton for wages and salaries in production.

Figure 3 shows the pattern of costs for wages and salaries for production work when plotted in relation to the yearly volume of operations. On the basis of these data, apparently plants mixing 1,000 tons of feed a year can be expected to have an average cost of about $9.50 a ton for wages and salaries for production; a plant with 5,000 tons a year, about $5.90 per ton; 30,000 tons a year, $3.75 a ton. In plants mixing more than 30,000 tons a year, per-ton costs tend to decrease at a slower rate in relation to the increase in the volume mixed.

This line of average relationship showing the influence of volume of feed mixed on the wage and salary cost of production has a coefficient of determination of 0.63. This means that when the volume of feed mixed is considered, it explains about 63 percent of the variation among plants in the costs for wages and salaries in production.

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[10] Definitions are contained in the methodology section of the appendix, pp. 39-45.

Table 18.- Percentage of establishments reporting wages and salaries for production, per ton of feed mixed, by size of cost and operating volume 1/

Tons of feed mixed per year	Plants	Under $4	$4.00-$5.99	$6.00-$7.99	$8.00 and over	Total
	Number	Percent	Percent	Percent	Percent	Percent
Under 2,000......	9	0	11	33	56	100
2,000 - 4,999....	11	9	45	36	10	100
5,000 - 14,999...	29	14	59	17	10	100
15,000 - 24,999..	10	50	40	10	0	100
25,000 and over..	36	69	28	3	0	100

1/ Ninety-five establishments supplying data and receiving more than 50 percent of their gross receipts from the feed department.

Any plant manager or prospective owner or manager can compare his production costs for wages and salaries with the industry average trend line in figure 3 -

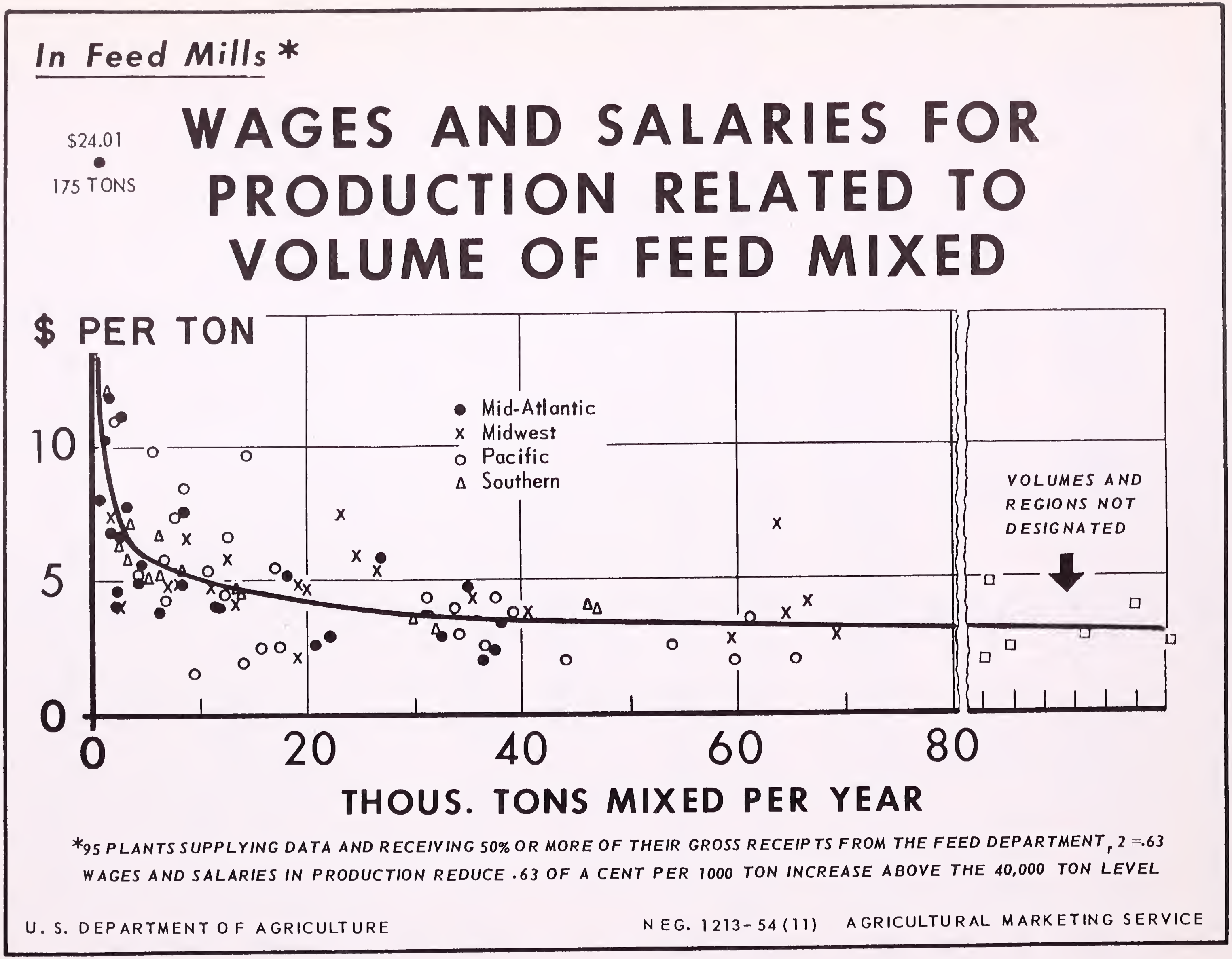
(1) By determining his volume of feed mixed during a year.

(2) By estimating the total wages and salaries attributable to production, as defined in the Appendix, from records of wage and salary payments.

(3) By dividing item 2 above by item 1 above and comparing the result with the per-unit costs as shown by the line of average relationship in figure 3.

For example, a hypothetical plant mixing 15,000 tons of feed in 1953 paid $105,000 for wages and salaries in production during the same period, or $7 per ton. Turning to figure 3, and proceeding from left to right on the horizontal scale, a line will be found representing 15,000 tons a year. Moving upward on this line and stopping at the point where it intersects the industry line of average relationship, and then going horizontally to the left, one can read the industry-average per-unit cost for plants of this size, that is, $4.70. A comparison of these two per-ton cost estimates indicates that the hypothetical plant has a higher wage and salary cost than many other plants in the industry. It also shows that there probably is some room for reviewing the production wages and salaries with a view to increasing the operating efficiency in this respect.

In working with these costs of wages and salaries in production, it should be remembered that not only does this cost represent about 60 percent of the total, but that it is a relatively variable expense item. In other words, the total economies of scale (considering only this one factor) in terms



In Feed Mills *

WAGES AND SALARIES FOR PRODUCTION RELATED TO VOLUME OF FEED MIXED

*95 PLANTS SUPPLYING DATA AND RECEIVING 50% OR MORE OF THEIR GROSS RECEIPTS FROM THE FEED DEPARTMENT, r^2 =.63
WAGES AND SALARIES IN PRODUCTION REDUCE .63 OF A CENT PER 1000 TON INCREASE ABOVE THE 40,000 TON LEVEL

U. S. DEPARTMENT OF AGRICULTURE NEG. 1213-54 (11) AGRICULTURAL MARKETING SERVICE

Figure 3

of production expenses can be expected to exceed those shown in figure 3 because of the relatively fixed expenses. The reason is that the relatively fixed expenses tend to decrease somewhat more rapidly on a per-unit basis. This applies especially in the lower volume groups (table 13).

Volume and the Input of Man-Hours in Production

Thirty-seven out of a total of 40 plants mixing 15,000 or more tons a year require the input of less than 4 man-hours per ton of feed mixed (table 19). On the other hand, 16 of the 20 plants mixing less than 5,000 tons a year required an input of more than 4 man-hours per ton of feed mixed.

Table 19.- Percentage of establishments reporting man-hours required for production, per ton of feed mixed, by man-hours of input and operating volume 1/

Tons of feed mixed per year	Plants	Under 2 hours	2 to 4 hours	4 to 6 hours	6 hours and over	Total
	Number	Percent	Percent	Percent	Percent	Percent
Under 2,000........	8	0	0	25	75	100
2,000 - 4,999......	12	0	33	42	25	100
5,000 - 14,999.....	26	8	54	27	11	100
15,000 - 24,999....	9	44	56	0	0	100
25,000 and over....	31	52	38	10	0	100

1/ Eighty-six establishments supplying data and receiving more than 50 percent of their gross receipts from the feed department.

Up to this point, it has been shown that, in terms of dollars-and-cents costs in either total costs per ton or labor costs, no significant regional difference exists. In terms of physical inputs of labor for production, this statement apparently does not apply. On the basis of the plants included in the study, between 30 and 50 percent more labor input is apparently required per ton of feed mixed in the South than in any of the other areas. Differences in average wage rates apparently offset these additional man-hours to make labor costs comparable in all regions. Figure 4 indicates that all southern plants appear above the trend line, which best indicates the trend for the industry in the other regions, except for one large plant.

The survey of facilities gives some indication that this regional difference probably results from relatively less mechanization in Southern industry, although the survey is too sketchy in this respect to be conclusive. Lower labor productivity appears to be the only other possible answer for this difference.

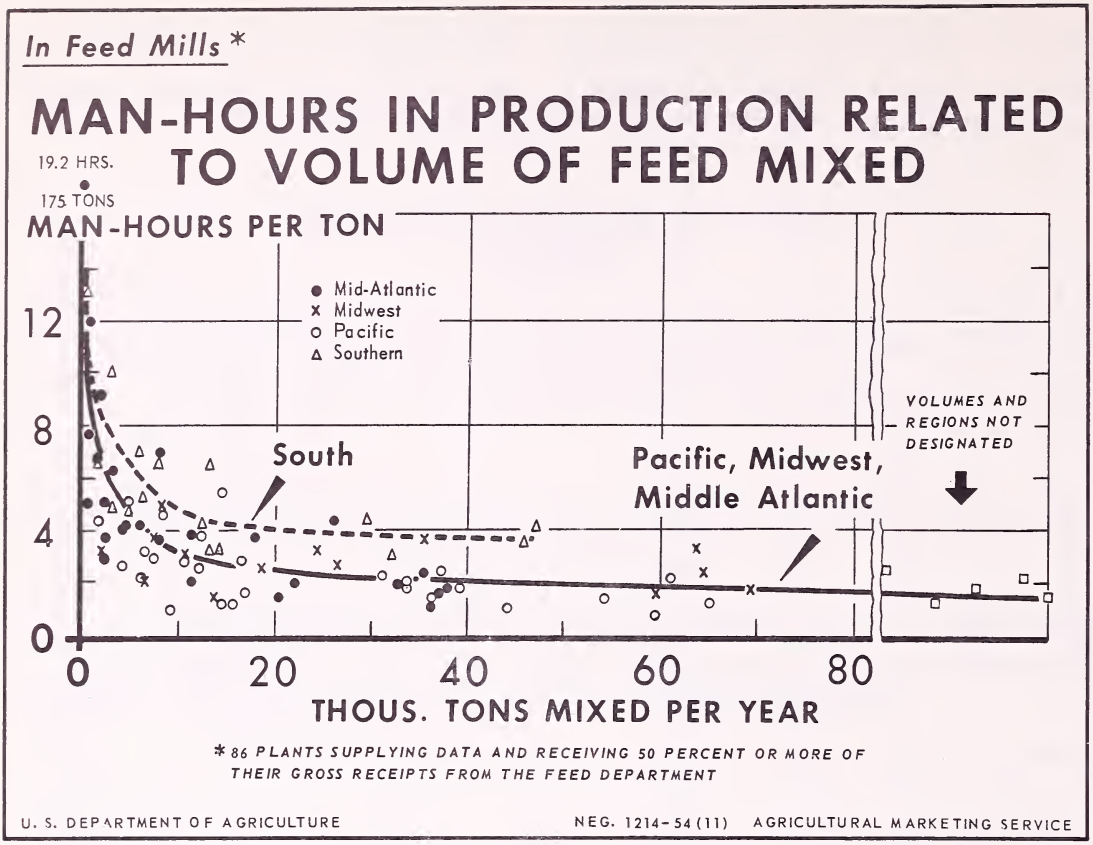


Figure 4

In the South, plants mixing about 2,000 tons a year require about 8 1/2 man-hours per ton of feed mixed, and plants mixing about 25,000 tons a year about 3 3/4 man-hours per ton of feed mixed. In the other areas, 6 1/2 and 2 1/3 man-hours, respectively, are required per ton in plants of similar volume.

Other Items Influencing Operating Costs

Many other items influence operating costs in addition to the volume of operation. In fact, the influence of volume may have been either understated or overstated somewhat in the preceding sections because some of these other items were not considered at the same time. For example, the meager information available on (1) the age of plant and equipment and (2) plant operations as a percentage of capacity both tend to correlate directly with plant volume and therefore, exert some influence in locating the lines of average relationships appearing in figures 2, 3, and 4. Certainly these items have at least resulted in increasing the variation around the industry trends shown in figures 2, 3, and 4. Or, in other words, a study of them can be expected to indicate that they are responsible for much of the remaining unexplained variations in per-unit operating costs.

Only a very thorough and intensive study would make it possible to determine how much of the variations in costs, for plants of a given volume, are explained, for example, by variations in the type of products produced. This interview survey merely attempts to analyze the most important "other items" in order to be able to show whether or not they change the shape, conformation, or level of the regression lines appearing primarily in figures 2 and 3. In other words it should show whether or not these individual "other items" appear to change the answers shown in the industry trend lines when only one factor "volume" is considered.

Type of Product

Obviously the costs of operating feed manufacturing plants vary considerably depending upon the type of product produced. For example, if plant A mixes only 10 percent of the feed processed, it would be expected to have very much lower costs per ton of feed handled than plant B, which mixes 100 percent of the feed processed, assuming both plants handle the same volume. On the other hand, if both plants A and B mix the same volume of feed, but plant A processes 10 times as much as plant B, the other 90 percent handled by plant A would make its costs per ton of feed mixed much higher than those expected for plant B.

Apparently, however, this is an extreme example, since none of the plants included in our analysis even approximated this amount of variation in the products handled. Table 20 shows the percentage of the total feed processed which is represented by the various degrees of work involved. Feed retailed has been excluded, because the comparison is made with the wages and salaries in production, which does not include the selling operation.

Table 20.- Percentage of feed processed by type of processing, by operating volume of plant 1/

Tons per year	Mixed feeds	Scratch feed	Minor processing			Total
			Ground	Pelleted	Bagged	
	Percent	Percent	Percent	Percent	Percent	Percent
Under 5,000	84	4	6	0	6	100
5,000 - 14,999	85	3	9	0	3	100
15,000 - 24,999	91	4	1	1	3	100
25,000 - 34,999	84	11	5	0	0	100
35,000 - 44,999	84	13	2	0	1	100
45,000 and over	91	4	4	0	1	100

1/ Ninety-eight plants receiving more than 50 percent of their gross receipts from the feed department.

Plants mixing less than 15,000 tons a year apparently grind and bag a little more feed for sale without mixing than do the larger plants. None of the plants seem to take much feed, mixed or unmixed, and merely pellet it for sale. A combination of mixed feeds and scratch feeds represents about 88 percent of the total feeds processed in these smaller plants as contrasted with about 95 percent in the larger volume plants (table 20).

So far, the analysis has disregarded the volume handled in this minor processing and has considered all feeds mixed, including scratch, as having comparable costs. Although this is not very realistic, it is a fairly good assumption because of the large proportion of the tons processed represented by mixed and scratch feeds. It is always difficult to estimate the cost relationship between various operations. But for the purpose of seeing whether or not the inclusion of these other categories of processing change the per-ton cost of manufacturing, let us assume the following: 11/

1 ton feed mixed 1/ = 1 ton
2 tons scratch feed = 1 ton
6 tons ground or bagged 2/ = 1 ton

1/ Includes mashes, crumbles, pellets, and so forth.
2/ Pelleted excluded because only 3 plants performed this individual operation on feed not mixed by them.

Computing new per-ton costs for the individual plants as shown in figure 3, apparently the industry average regression line showing the influence of operation volume on wages and salaries in production does not change significantly. Expenses for wages and salaries in production per (comparable) ton processed were about 10 cents higher in the lower volume area and 10 cents lower in the higher volume area than those appearing on a per-ton mixed basis in figure 3. 12/ Thus, the per-ton mixed basis apparently understates somewhat the economies of scale existing in the industry. However, for a few individual plants it tends to make them either more or less efficient than they appeared when only the tonnages mixed were considered. Whether they tended to become more or less efficient depended upon the degree to which the scratch feed and minor processing differed from that of the average plants.

11/ Tonnages were also computed on the basis of 0.2 ton each for cleaning, grinding, bagging, and pelleting; 0.5 ton for mixing; 0.3 ton for mixing scratch feed; and 0.1 ton for warehousing. This computation resulted in very little change in the coefficient of correlation and only a small shift in the industry trend line (fig. 2). The shift in the trend line was 20 cents less a ton for plants mixing less than 2,000 tons or more than 30,000 tons a year, and a maximum of 55 cents less per ton in 15,000-ton plants. Thus, changing the method of computation for comparable tonnages appears to change the number of tons and thus the level of the line of average relationship but not the shape and conformation of this line or its relative value.

12/ Both the standard deviation around the mean and the standard error around the regression line improve, but the correlation coefficient remains about the same.

Thus, for most plants operating in the mixed-feed industry, apparently a simple comparison of their costs per ton of feed mixed is sufficiently accurate. Only those plants with very unusual product relationships need to compute comparable tonnages before making this comparison.

Age of Plant and Capacity Production

Analyzing the influence of one factor (volume) on the costs of operation simplifies the results for industry use. Actually, however, much of the influence of other factors especially (1) the age of plant and equipment and (2) the proportion of capacity at which the plants operate, is, if intercorrelation exists, included in the regression lines shown in figures 2, 3, and 4. This appears to be true in the feed milling industry, since both the older plants and the lower proportion of capacity tend to be found in the smaller volume plants and vice versa. It should, however, be pointed out that this intercorrelation does not influence the value of using volume as a single factor to estimate average operating costs in the industry.

Information on the age of plant and equipment in the feed milling industry was difficult to evaluate in view of the large number of replacements and partial modernization which have occurred in this dynamic industry. Available information seems to indicate about the same results as are shown in the following analysis of operating volume as a proportion of capacity operation.

The most usable estimate of plant capacity for each feed-mixing plant appears to be the one in which each company assumed (1) its machinery and facilities as given, (2) its labor force of the size and quality and working the number and length of shifts that prevailed during the peak weekly output recorded for the plant, and (3) production of only its major type of feed. When this was used as the measure of capacity, the plant's annual production equaled the percentages of capacity shown in table 21.

When the 41 plants that reported operations at 41 through 80 percent of capacity are plotted, the regression line appearing in figure 3 still reflects the trend for these 41 plants. This means that the plants operating at less than 41 percent of capacity and those operating at more than 80 percent of capacity are found both above and below the industry trend line appearing in figure 3. Thus, while the current operating rate, expressed as a percentage of capacity, influences the operating costs per ton, apparently it merely increases the variation around the average line of relationship (figs. 2, 3, and 4).

Table 21.- Percentage of plants operating at specified percentages of capacity by tons of feed mixed

Tons of feed mixed per year	Plants	0-20 per-cent	21-40 per-cent	41-60 per-cent	61-80 per-cent	81-100 per-cent	Total
	Number	Percent	Percent	Percent	Percent	Percent	Percent
Under 5,000	12	25	25	33	17	0	100
5,000 - 14,999	24	13	41	17	25	4	100
15,000 - 24,999	11	27	0	45	18	10	100
25,000 - 44,999	13	8	8	38	23	23	100
45,000 and over	15	0	6	20	47	27	100

Seasonality of Production

A considerable difference in the seasonal production patterns for the various plants could also influence the per-ton costs computed on an annual basis. This is especially true if some plants have a pronounced seasonal pattern and others have only a minor seasonal pattern. If this pronounced variation exists between plants, variations in monthly production would in all probability explain some of the variations around the industry trend line.

Analysis of the seasonality of mixed-feeds production in the United States and various geographic areas 13/ have indicated (1) that recently seasonality has not been very pronounced and (2) that it has been decreasing as the industry has grown. Industry averages of this sort appear to cover up the considerable seasonal variations experienced by the individual plants (table 22).

Undoubtedly one of the reasons why seasonality evens out for the industry as a whole while it varies considerably in individual plants is that there apparently is no general seasonal pattern among the individual plants until a volume of 35,000 tons a year is achieved. Plants mixing more than 35,000 tons a year appear to have their high production months in the late spring and summer and their low production months in the winter. Almost as many of the smaller plants had high production months in the winter as had them in the summer.

In the Midwest, an attempt was made to obtain information on the within-plant influence of volume changes on the per-ton costs of wages and salaries in production. Iowa State College was able to obtain usable monthly volume and cost records for 15 plants.

13/ Askew, William R., and Brensike, V. John. The Mixed-Feeds Industry. U. S. Dept. Agr., Mktg. Res. Rept. #38, 24 pp., May 1953, and periodic reports of the American Feed Manufacturers Association.

Table 22.- Percentage increase from the low to the high month in the monthly production of mixed feeds, by tons of feed mixed per year

Tons of feed mixed	Plants	Low plant	High plant	Average plant
	Number	Percent	Percent	Percent
Under 5,000	12	0	160	60
5,000 - 14,999	28	0	248	84
15,000 - 24,999	10	0	332	95
25,000 - 34,999	7	0	95	32
35,000 - 44,999	8	5	202	62
45,000 and over	16	21	226	58

Data obtained from these 15 plants indicate that the per-ton cost for wages and salaries in production decrease as volume increases. The data also showed that there was a tendency for the percentage decrease per ton to be largest, over the operating volume area, in those plants having the smallest seasonality (table 23). This implies that many of the plants with the smallest seasonality were able to vary their production staff more adequately for slack and high production periods than was the case in most plants with larger seasonal variations in volume. In other words, as volume increases within a plant, the costs of wages and salaries in production tend to decrease at a decreasing rate within the operating volume ranges considered.

Proportion of Total Output Represented by One Type of Feed

A number of people associated with the feed-mixing industry felt that operating costs per ton could be expected to be somewhat lower in plants where a large proportion of the feed mixed was, for example, poultry feed or dairy feed. It appears, however, that the inclusion of small amounts of molasses in many poultry feeds and the large number of minor ingredients in nearly all types of feeds has tended to equalize costs somewhat in recent years. The variety of ingredients and supplements, each frequently serving slightly different purposes, has resulted in even straight poultry-feed plants producing as many brands or mixes of feeds as most diversified feed plants. It further appears that the number of starts, stops, and cleanings required are more important than the proportion of output represented by the major type of feed.

Table 23.- Percentage change in the cost per ton of wages and salaries in production as monthly volume changes, in Midwestern plants, by tons of feed mixed

Tons of feed mixed and rank of plant	Volume rank in		Percentage		
			Increase in volume:	Decrease in costs	
	Lowest cost month	Highest cost month	from high to low cost month	From high to low cost month	Per ton for one percent increase in tonnage
			Percent	Percent	Percent
Under 5,000					
1	Highest	Lowest	233	70	.30
2	Highest	Lowest	175	64	.37
3	Highest	Lowest	131	57	.44
4	Highest	Lowest	83	45	.54
5	Highest	Lowest	45	31	.69
6	2nd highest	Lowest	1/ 150	2/ 39	.26
7	Highest	Lowest	1/ 108	2/ 49	.45
5,000 - 14,999					
8	2nd highest	7th lowest	1/ 82	2/ 36	.44
9	8th highest	3rd lowest	1/ 117	2/ 52	.44
10	Highest	Lowest	89	40	.45
15,000 - 24,999					
11	4th highest	6th lowest	1/ 41	2/ 19	.46
12	Highest	Lowest	591	66	.11
25,000 - 34,999					
13	8th highest	4th lowest	1/ 55	2/ 8	.15
14	3rd highest	2nd lowest	1/ 51	2/ 31	.61
Over 35,000					
15	4th highest	7th lowest	1/ 99	2/ 10	.10

1/ Volume increases computed from the average volume in the low months to the average volume in the high months.

2/ Cost decreases computed from the average costs in those months of low volume to those months with high volumes.

Actually, however, there apparently is little difference between large and small plants in the proportion of total output represented by the major type of feed (table 24). Therefore, even if the proportion of feed mixed represented by one type were important, it would only tend to increase the variation in costs around the industry trend line rather than change the shape or conformation of the line itself.

Table 24.- Percentage distribution of plants by specified proportion of total output represented by the major types of feed, by volume of feed mixed

Tons of feed mixed per year	Plants	0-25 percent	26-50 percent	51-75 percent	76-100 percent	Total
	Number	Percent	Percent	Percent	Percent	Percent
Under 5,000	20	0	30	40	30	100
5,000 - 14,999	29	0	28	21	51	100
15,000 - 24,999	12	0	17	58	25	100
25,000 - 44,999	18	6	22	44	28	100
45,000 and over	17	0	16	60	24	100

Pelleting

Plants mixing 5,000 or more tons a year pelleted about one-third of their output. The smaller plants tended to pellet only about one-tenth of the feed ground or mixed in the plants. This service not only requires additional equipment and labor but also must carry some of the space and overhead expenses. 14/

Table 25 indicates that there is a definite tendency for the larger plants to pellet a larger proportion of the feed processed. In view of this fact and that this service entails added costs, the industry cost curves (figures 2, 3, and 4) appear to understate somewhat the influence of volume on the per ton costs of wages and salaries in production.

Custom-Mixed Feeds as a Proportion of Total

Until recently, custom mixing was considered a very good indication of the number of starts and stops required in the mixing of a given volume. Thus, the greater the proportion of custom-mixed feeds, the more likelihood of a

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14/ Rickey, L. F., Costs of Pelleting Feeds at Selected Cooperative Feed Mills. U. S. Farm Credit Admin. Bull. 63. May 1951.

Table 25.- Percentage of plants pelleting specified percentages of feed ground or mixed, by volume groups

Tons of feed mixed per year	Plants	0 percent	1-20 percent	21-40 percent	41-60 percent	61-80 percent	81-100 percent	Total
	No.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Under 5,000	20	80	5	0	0	10	5	100
5,000 - 14,999	30	37	34	3	3	13	10	100
15,000 - 24,999	12	17	33	0	17	8	25	100
25,000 - 34,999	8	0	75	13	0	0	12	100
35,000 - 44,999	10	10	40	20	20	0	10	100
45,000 and over	17	6	34	18	18	18	6	100

larger number of starts and stops and their resultant probable increased cost per ton mixed. This assumption has become less appropriate with the increased production of a larger number of feeds using different ingredients, and including supplements, vitaminized, antibiotic, and medicated feeds, each requiring a different mix.

To the extent that this factor still influences operating efficiency, the per-unit costs are probably overstated somewhat in the smaller-volume plants (table 26). Actually, however, because the smaller plants are operating at less than capacity, it is possible that these stops, starts, and cleanings do not increase their operating costs per ton very much.

Table 26.- Percentage of plants custom mixing specified percentages of feed mixed, by volume groups

Tons of feed mixed per year	Plants	0 percent	1-10 percent	11-20 percent	21-30 percent	31-40 percent	41-50 percent	50 percent and over	Total
	No.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Under 5,000	20	25	20	5	5	5	10	30	100
5,000 - 14,999	30	57	23	7	0	10	3	0	100
15,000 - 24,999	12	67	25	0	8	0	0	0	100
25,000 - 34,999	8	50	25	0	13	12	0	0	100
35,000 - 44,999	10	80	10	10	0	0	0	0	100
45,000 and over	17	88	6	6	0	0	0	0	100

Sales in Bag or Bulk

The relative costs of bag or bulk production and merchandising are debatable, and it is difficult to tell from the data available which method has the advantage of lower cost. Certainly this study does no more than to indicate that both types of plants fall within the average deviations on both sides of the industry trend line of per-ton costs, and that therefore neither has any extremely large cost advantage over the other.

On the average, however, apparently both the large and the small establishments bag about the same proportion of the total products handled (table 27). In view of this fact, apparently neither bag nor bulk sales should influence the shape or conformation of the industry average lines of relationship appearing in figures 2 and 3.

Table 27.- Percentage of plants bagging specified percentages of feed handled, by volume groups

Tons of feed handled per year	Plants	0-25 percent	26-50 percent	51-75 percent	76-100 percent	Total
	Number	Percent	Percent	Percent	Percent	Percent
Under 5,000	16	13	6	0	81	100
5,000 - 14,999	26	15	0	27	58	100
15,000 - 24,999	15	0	0	27	73	100
25,000 - 34,999	7	14	0	14	72	100
35,000 - 44,999	11	9	0	27	64	100
45,000 and over	19	5	12	5	78	100

Managerial Decisions

Management is the most important of the factors referred to by the feed-mixing industry as the 4 M's--management, money, manpower, and machines. In economic terms, management is the key to the allocation of the factors of production.

If management performs this task of allocating these factors satisfactorily, the operation potentially becomes an efficient one. On the other hand, it can never become a truly efficient operation if this step is performed in a merely mediocre manner. In addition, management performs many tasks within each of these 4 M's which individually influence operating efficiency considerably. For example, it can recruit and train the manpower and keep it happy and interested in high production, or it can make manpower turnover high and efficiency low.

Using machines and money, management can build and equip a plant efficiently. To do so, however, it must properly plan for the possible capacity and services demanded in the sales area. It must also join current type equipment together in a plant layout which minimizes the bottlenecks for the normal and potential flow of material through the plant. In an industry as dynamic as the feed-milling industry, a plant and its equipment soon become at least partially obsolete. In this event, the management has to choose the type and the extent of remodeling which will pay for itself through increased efficiency and savings.

These decisions, of course, are not easy especially in an industry as complicated as that producing mixed feeds. The average plant produces a large variety of feeds, particularly in performing custom work, and such production results in many stops and starts for all equipment during a regular day's work. Some of the large concerns produce as many as 80 brands of feed, and the custom work in smaller mills tends to complicate the operation in the same way. As many as six changes an hour or about 50 per shift can result. Further complicating the operation is the fact that many of these feeds are sold as mash, pellets of many sizes, or crumbles; medicated or not; with special ingredients or without; and in cotton, print, or paper bags of many sizes, or in bulk.

Management appears to be the factor which explains why, even in the face of substantial economies of scale, some of the smaller volume plants can produce mixed feeds nearly as cheaply as some of the larger volume plants. Or, stating it in a different way, the efficiency or lack of efficiency, interest, and emphasis in management explains most of the variations in per-ton costs around the volume group averages. This appears to be substantiated somewhat by the fact that these variations around the industry average cost curve tend to decrease as volume increases, and presumably the emphasis on and the interest and ability of management tend to become more constant.

This hypothesis naturally requires testing. Thus, it is hoped that studies in this field can be made in a smaller number of plants, operating in a similar volume area, to determine the importance of management and related factors in explaining the differences in operating costs when the influence of volume has been excluded. It would also be helpful to determine the influence of managerial decisions on the cost of raw materials and on savings in selling costs.

Management must also decide whether or not, even in the face of some fairly large economies of scale, a given plant should increase its volume. As can be noted from the variations around the per-ton average cost line, reductions in production expenses per ton do not automatically follow an increase in the volume mixed. Management or facilities may not be able to handle the increased production as efficiently, and certainly the added costs of selling this added quantity may make the entire operation more inefficient than it was at the lower operating level.

APPENDIX

Methodology

Schedule

The first draft of the schedule used in this study was prepared by the authors and revised after review by (1) other members of the U. S. Department of Agriculture who had worked with the feed-mixing industry, (2) representatives of the contracting institutions, (3) representatives of the American Feed Manufacturers Association, and (4) plant managers and other representatives of the trade. Throughout the preparation, review, and testing of this schedule, the costs of operation were considered the central objectives of the study. Information on volume and services rendered were included only if they were believed to influence operating costs. Costs of raw material, value of the finished products, and profit items were not requested. Nor were sideline interest items, such as the source of raw materials, and sales areas included in the schedule of questions.

Plant Contacts

Each of the contracting institutions used its own procedure to initiate contacts with the plant owners or managers. However, all contacts were eventually made by personal interview, with at least the cost and volume records available to the interviewee, the interviewer, or both. Most of the schedules were entirely completed during this interview, although occasionally cost or volume information was left for the bookkeeper or accountant to complete and mail at a later date. As mentioned previously, many of the plant managers were sufficiently interested in the findings that they let the interviewer use their records or did additional summarizing themselves to obtain the more general type of descriptive information. All data obtained covered the last fiscal year for which records were available in each plant. All interviews were conducted between July 1 and December 1, 1953.

Completion of the questionnaire took from 1 to more than 3 hours per plant, depending on the number of interruptions, the size of the plant, and the type of records available. In the Iowa area considerably more time was required to complete the schedules, since many of these plants supplied monthly costs and volume information as well as the regular annual data.

Sampling

To make a study of this type, it was thought necessary to have the cooperation of between 100 and 200 plants out of the 2,689 operating in the United States according to the definition used in the 1947 Census of Manufactures. Obtaining this degree of cooperation from firms operating throughout the operating volume area and located in any specific geographic area of the United States was deemed to be too great a task, if indeed it could be accomplished. In addition, this type of survey would not indicate whether the results could be applied to other areas nor indicate the degree to which per unit operating costs tended to vary between regions.

As a result, it was decided to survey the feed-mixing plants in five major areas of the United States through contracts with Agricultural Experiment Stations located in the Middle Atlantic, Southern, Midwestern, Texas and Oklahoma, and Pacific areas. Timing and other internal factors did not permit the study to operate in the Texas and Oklahoma area, and AMS personnel conducted the work in the Middle Atlantic area. The work, including field work and preliminary area analyses, was conducted in Oregon, Washington, and California by the Agricultural Economics Department of Oregon State College. Work was done in Iowa, Minnesota, South Dakota, Nebraska, and Illinois by the Agricultural Economics Department of Iowa State College. It was conducted in Tennessee, Alabama, Georgia, and North and South Carolina by the Agricultural Economics Department of the University of Tennessee (fig. 1). AMS personnel visited plants located in the Middle Atlantic States of Pennsylvania, New York, New Jersey, Delaware, and Maryland, as well as some plants in many of the other States, in order to coordinate the study as much as possible. A sample of 45 plants and their alternates were chosen in each of these areas, except the Middle Atlantic area, where a 35-plant sample was used.

Only one visit was made to each plant. If the keymen, such as plant owners or managers, were away, or if a refusal was encountered or the plant did not mix any feed, an alternate plant was used. If less than 35 plants cooperated out of each of these samples, a supplemental sample of 15 was chosen for contact. Only three supplemental plants were visited in the Middle Atlantic area. Six supplemental plants were chosen in the Midwest in order to maintain the internal geographic sampling ratio, and complete supplements were chosen in the Pacific and Southern areas. However, only 10 were contacted in the Pacific area before the minimum of 35 cooperating plants was achieved.

The plant managers contacted in the survey were quite interested in the study, and cooperation was generally good. In many instances, the key plant men went to considerable trouble to obtain and summarize their records, even for the service and descriptive items for which only estimates were requested. Table 1 in the text shows by areas, the number of plants contacted and schedules completed in the study.

Five of the 126 cooperating plants were excluded from the analysis. The operations of two were entirely different from any of the others. One produced and sold only mineral feeds and the other was a soybean processing plant which also mixed some feeds. The remaining three were excluded because the only costs which they had available for the feed-mixing department were those of production, excluding such items as handling ingredients, storage, and handling out-movements of finished feeds. This definition of costs was much too restricted for direct comparability with the remaining plants.

Sample plants and their alternates were chosen from trade association membership lists, reports of State licensing agencies, the World War II War Food Order records, and a trade publication 15/ listing feed mills in the United States and Canada. The latter two lists gave some volume or capacity designations for many of the plants in addition to the names and addresses. A consolidation of these lists was then sampled at random within geographic and operation volume strata. Small-volume plants were sampled at a lower rate than were the medium and larger volume plants in order to insure the contacting of sufficient large-volume firms in this small sample.

When capacity or volume data were not available for a plant, the plant was placed in an unknown-volume group and sampled at random within given geographic areas. Supplemental samples were chosen, insofar as possible, to fill operating volume areas with few or no cooperating plants, if such areas arose. The sample is somewhat inadequate for the following two reasons:

(1) The different types and coverage of the lists available in the different areas.

(2) The fact that no volume or capacity data were available for many of the plants. This lack of data made it difficult to draw the original sample and to obtain representative alternates.

As a result of the above problems, it was not possible to represent each volume group in each geographic area, either on a proportional basis or on the basis of a known sampling ratio. Sampling on a known sample ratio was, however, attempted in the Iowa area, where somewhat more volume information was available.

Sample Distribution with Census Comparisons

The 126 plants cooperating in the survey ranged from plants handling less than 1,000 tons of feed a year to some handling more than 150,000 tons a year. As was pointed out previously, the sample was designed to contain relatively few of the small plants and relatively more of the large plants. To sample at a uniform rate would have wasted limited resources and resulted in a sample primarily loaded with small plants. Table 28 indicates the average size of plants as reported by the 1947 Census of Manufactures and the average size of plants in the survey for the most comparable geographic areas and definitions. When all the sample plants are included in the comparison, the same general picture results.

15/ Feed Mills in the United States and Canada, published by Feedstuffs, 1953.

Table 28.- Average volume of feed mixed per plant in sample plants and of ingredients consumed as reported by Census, by geographic areas

Area	Average volume per plant	
	Sample 1/	Census
	Tons	Tons
Middle Atlantic 2/	18,400	11,500
Tennessee 3/	25,100	13,700
Iowa 3/	16,400	3,300
Pacific 4/	32,100	7,200

1/ Average for all plants (census definition) mixing more than 2,000 tons a year and receiving more than 50 percent of their gross receipts from feed department.

2/ Includes sample plants in New York, New Jersey, and Pennsylvania for the best possible comparison.

3/ Tennessee and Iowa not only contained a majority of the sample plants but were the only areas for which data were comparable to those of the census.

4/ Sample and census both cover Oregon, Washington, and California.

The best comparison that can be made between the sample plants and the census pertains to wage and salary relationships. Not only is this one of the key factors studied in this analysis but the same definitions of production and related workers were used. Naturally, some differences in interpreting the definitions may have occurred. And the Bureau of the Census admits that it was impossible for it to keep all ingredients sold as such out of its item entitled "ingredients consumed by the industry."

Basically, however, the comparison is valid and the differences are susceptible to rationalization (table 29). For example, wages and salaries per ton seem to be lower in the sample than they were in the census. Production wage payments are even lower relatively. This difference should be expected, since the sample overstresses the larger volume plants. These larger volume plants can be expected not only to have a lower per-unit cost of production but also to expend a larger proportion of the total wage and salary dollar for employees working in the office and in the sales and similar departments.

A recent report of the Farmer Cooperative Service 16/ indicates that about 25 percent of the commercial feed is produced in cooperative feed plants. In this study 31 of the plants were cooperatives and 89 were proprietary organizations. Roughly the same portion exists throughout the range of operating volumes.

16/ Rickey, L. F. Feed Bags--Kinds, Costs, and Problems. U. S. Farmer Coop. Serv. Cir. 2. April 1954.

Table 29.- Wages and salaries per ton of feed, total and for production, from the sample and as reported by the 1947 census, by geographic areas

Area 1/	Wages and salaries per ton					
	Sample 2/			1947 Census 3/		
	Total	Production	Production as a percent of total	Total	Production	Production as a percent of total
	Dollars	Dollars	Percent	Dollars	Dollars	Percent
Middle Atlantic	6.59	3.21	49	5.73	3.88	68
Tennessee	5.44	3.01	55	5.89	3.55	60
Iowa	7.13	3.41	48	10.14	6.29	62
Pacific	5.31	3.18	60	8.57	5.92	69

1/ See footnotes, table 28.
2/ Tons of feed mixed, fiscal years 1951-53.
3/ Tons of ingredients consumed.

Definition of Cost Items

Feed-Mixing Plants.- Feed milling included grinding, pelleting, bagging, and merchandising of both individual grains and mixed feeds prepared by others as such (if the plant also mixed some feeds), as well as the actual mixing of feeds. The only major deviation from this definition occurred when grain elevator sales of grain ingredients were large enough so that the owner or manager considered it a separate operation and costs allocations were possible.

Labor.- By far the largest cost item, labor was defined to include all wages and salaries paid as well as estimated wages and salaries for unpaid time which the proprietor or partners spend in working or managing the enterprise. Going wages for common labor was used to estimate this unpaid time. All wages and salaries were reported before deductions for retirement, unemployment insurance, group insurance, withholding tax, bonds, and union dues, but after deductions for "damaged work" (deductions from wages for damage done by a workman). Wages and salaries also included an estimate for rent, fuel, meals, or other payment in kind, as well as payment for overtime, sick leave, holidays, and vacation taken during the pay periods reported, but they excluded cash payments made for vacations not taken.

Wages and salaries paid and man-hour inputs for production workers cover all working foremen and all nonsupervisory workers (including leadmen and trainees) engaged in fabricating, processing, assembling, inspection, receiving, storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial, and watchman services, product development, auxiliary production for the plant's own use (for example, power plant), and record-keeping and other services closely associated with the production operations. They also include an estimate to cover payments to executives and other supervisors, above the level of working foremen's salaries, which were attributable to production rather than the following excluded types of work:

> Executive (except that attributed to production), purchasing, finance, accounting, legal, personnel, cafeteria operation, medical, professional, and technical activities, sales, sales delivery, advertising, credit, collection, and installation and servicing of own products, routine office function, and construction employees on the payroll engaged in the construction of major additions or alterations to the plant (called "force account" employees in the census reports).

In plants not having sufficient detail in their man-hour and wage-and-salary records all allocations were made for individual workers and accounted for 100 percent of each worker's time.

Depreciation.- This relatively large individual expense item was obtained as a total in the total-cost question, and it was itemized in another question covering the following breakdown: Warehouse, mill, elevator storage, other buildings, mill equipment and machinery, and other machinery and equipment.

Taxes and Licenses.- This expense was defined to cover all taxes and licenses paid except State and Federal income taxes and those taxes already included in the wages and salaries expense item.

Transportation and Hauling.- Transportation and hauling costs, as used in this report, cover primarily the expenses of this type incurred within the organization itself. The item was defined in the negative to exclude all transportation costs paid to carriers of any type as payment for moving ingredients to the plant or finished products from the plant to the purchaser.

Containers.- The cost of bags, tags, twine, and other container materials was considered to be a raw material cost rather than an operating cost item.

Total Operating Costs.- Total operating costs cover all of the expenses defined above plus all other expenses included in the individual plant records as covering purchasing, assempling, handling, warehousing, mixing and related operations, selling, and overhead. Thus, for example, ingredient costs, costs of freight in and freight out, and the costs for bags, tags, twine or other containers were not considered.

These costs do not include returns to processors for their capital invested. It is recognized, however, that the feed mill proprietors must expect in the long run to receive a return above all costs which will be sufficient to attract capital and capable management to maintain the industry as an adequate and efficient provider of these needed marketing services.

Nearly all of the records either fit these definitions directly or were easily reconciled. Thus, all of the above definitions were included more as a safeguard to obtain comparable data than as a basis for reworking the plant records.

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